APPENDIX L

ASSUMPTIONS

This appendix describes assumptions that were made for the development of the wet weather and dry weather TMDLs. TMDLs were calculated for both wet and dry conditions; therefore the assumptions involved in both sets of calculations are described below. Additionally, some general assumptions were made regarding overall conditions in the environment affecting bacteria subsistence and growth. These assumptions were intended to be conservative in nature, therefore generating an implicit margin of safety for the TMDLs.

Wet Weather Modeling Assumptions

The watershed modeling system developed to represent wet weather conditions is described in Appendix J of the Technical Report. The following assumptions are relevant to the LSPC model developed to simulate wet weather sources of bacteria in the region.

- *General LSPC/HSPF Model Assumptions* - Many model assumptions are inherent in the algorithms used by the LSPC watershed model and are reported extensively in Bicknell et al. (1996).
- *Land Use* - A combination of SCAG, SANDAG and MRLC land use GIS datasets is assumed representative of the current land use areas. For areas where significant changes in land use have occurred since the creation of these datasets, model predictions may not be representative of observed conditions.
- *Stream Representation* - Each delineated subwatershed was represented with a single stream assumed to be a completely mixed, one-dimensional segment with a trapezoidal cross-section.
- *Hydrologic Modeling Parameters* - Hydrologic modeling parameters were developed during previous modeling studies in southern California (e.g., Los Angeles River, San Jacinto River) and refined through calibration to streamflow data collected in the San Diego Region. Through the calibration and validation process (summary statistics reported in Appendix M of the Technical Report), a set of modeling parameters were obtained specific to land use and hydrologic soil groups. These parameters are assumed to be representative of the hydrology of other watersheds in the San Diego Region that are presently ungaged and therefore unverified.
- *Water Quality Modeling Parameters* - Dynamic models require a substantial amount of information regarding input parameters and data for calibration purposes. All sources of indicator bacteria from watersheds are represented in the LSPC model as build-up/wash-off from specific land use categories. Limited data are currently available in the San Diego Region to allow development of unique modeling parameters for simulation of build-up/wash-off, so parameters were obtained from a similar study performed in the Los Angeles Region. These build-up/wash-off modeling parameters were originally developed by the Southern

California Coastal Water Research Project (SCCWRP) for a watershed model of the Santa Monica Bay Beaches (Los Angeles Water Board, 2002) and are assumed representative of land use sources in the San Diego region. This assumption was validated through evaluation of model results with local data. Summary statistics of model validation are reported in Appendix M of the Technical Report.

- *Lumped Parameter Model Characteristic* - LSPC is a lumped-parameter model and is assumed to be sufficient for modeling transport of flows and bacteria loads from watersheds in the region. For lumped parameter models, transport of flows and bacteria loads to the streams within a given model subwatershed cannot consider relative distances of land use activities and topography that may enhance or impede time of travel over the land surface. Although this limitation could result in mistiming of peak flows or under-prediction of bacteria die-off because overland losses are not simulated, impacts are assumed minimal.
- *Bacteria Loading Rates* – Bacteria loading rates associated with various land use categories are constant. Rates estimated for current loading are accurate for establishing total allowable loading for each land use category.
- *First-order Bacteria Die-off* - Each stream is modeled assuming an apparent first-order die-off of bacteria. Bacteria die-off rates for wet weather are assumed to be 0.8/day, based on sensitivity analyses performed by SCCWRP (Los Angeles Water Board, 2002).
- *In-stream Bacteria Re-growth* - The LSPC model assumes no in-stream regrowth of bacteria. No data or literature were located to provide indication that such sources are significant during wet weather or could be estimated for model input.

Dry Weather Modeling Assumptions

The watershed modeling system developed for simulation of steady-state dry weather flows and sources of bacteria is described in Appendix K of the Technical Report. The following assumptions are relevant to that discussion.

- *Channel Geometry* - Channel geometry during low-flow, dry weather conditions is assumed to be represented appropriately using equations derived from flows and physical data collected at 53 USGS stream gages in southern California.
- *Steady-state Model Configuration* - Although dry weather flows and bacteria densities vary over time for any given stream, for prediction of average conditions in the stream, flows and concentrations are assumed to be steady state.
- *Plug Flow Model Configuration* - Plug flow reaction kinetics are assumed sufficient in modeling dry weather, steady-state stream routing and bacteria die-off (with first-order die-off).
- *Sources for Characterization of Dry Weather Conditions* - Data used for characterization of dry weather flows and water quality are assumed representative of conditions throughout the region.
- *Methods for Characterization of Dry Weather Conditions* - The equations derived through multivariable regression analyses are assumed sufficient to represent the dry weather flows and water quality as functions of land use and watershed size.

This assumption was verified through model calibration and validation (summary statistics reported in Appendix M of the Technical Report).

- *First-order Bacteria Die-off* - Each stream is modeled assuming an apparent first-order die-off of bacteria. First-order rates were obtained through model calibration and verified as consistent with ranges reported by the USEPA (1985). These values were determined for fecal coliform, total coliform, and enterococci bacteria as 0.137/day, 0.209/day and 0.145/day, respectively. These die-off rates are assumed representative of all streams studied in the region.
- *Bacteria Re-growth* - The dry weather model assumed no in-stream sources or regrowth of bacteria. No data or literature were located to provide an indication that such sources are significant during dry weather or could be estimated for model input.
- *Stream Infiltration* - Losses of volume through stream infiltration were modeled assuming infiltration rates were constant for each of the four hydrologic soil groups (A, B, C and D). Infiltration rates were based on literature vales and refined through model calibration and validation (summary statistics reported in Appendix M of the Technical Report). The resulting infiltration rates were 1.368 in/hr (Soil Group A), 0.698 in/hr (Soil Group B), 0.209 in/hr (Soil Group C) and 0.084 in/hr (Soil Group D). These infiltration rates are within the range of values given in literature (Wanielisata et al., 1997). These infiltration rates are assumed representative for all streams studied in the region within each hydrologic soil group.
- *Dilution From Groundwater* – Dilution factors caused by groundwater base flows were not considered.